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## SOMETHING IN THE AIR AND ON THE ROAD: CARBON EMISSION AND OUR NATION'S LARGEST SOURCE OF CO2

GENERICSCIENCE CLIMATE CHANGE, CO2 EMISSION, GLOABL WARMTH

When talking about the environment and climate change, the conversation will inevitably turn to carbon. Often tossed into that discussion are things like emissions or your carbon footprint.

But what do these terms really mean? Not just for us, but future generations? And do they, or what producing them really matter in the grand scheme of things?

Let's take a closer look at carbon and carbon emission, and the industry that continues to propel our country's carbon footprint to concerning new heights.

### EVERYWHERE, ALL AT ONCE

A little background on carbon and climate change.

Carbon is everywhere. Seriously, it's all over the place – omnipresent, everywhere all at once. In the air, we breathe. It's also in our food, in our bodies, and the make-up of animals, plants, and trees.

As an incredibly abundant element, carbon, and carbon-based molecules are a fundamental building block for life.

Something else that is everywhere all at once is the climate. More specifically, climate change. Now, regardless of which side of the climate change debate you fall on – is it real, is it not – climate change is an actual thing.

In its most basic definition, climate change is a shift in predominant weather patterns that result in long-term weather changes to a region or globally. Typically, the resulting change can last anywhere from a decade or two to upwards of millions of years.

A volcano erupting over a long period of time, spewing ash into the atmosphere, can induce a change in the climate could eventually impact the entire planet. A strong or weak El Nino oceanic pattern can affect climate change. Influences from solar output can induce climate change, too.

### CARBON + CLIMATE CHANGE ACTUALLY = CARBON DIOXIDE



So where does carbon fit in the larger discussion about climate change?

When looking at climate change, carbon is meant to infer carbon dioxide or CO<sub>2</sub>. Often, this creates confusion as carbon and carbon dioxide are not the same thing.

Carbon is an element, a solid. Carbon dioxide is a gas – a greenhouse gas at that. Too much in the atmosphere and temperatures increase, and the end result is Earth heating at an unnaturally high rate.

When referencing carbon and its impact on climate change, what people are really speaking to is the impact of carbon dioxide.

Whether or not the misleading nature of using carbon in place of carbon dioxide is meant to tip the climate change discussion one way or another, is a conversation for another day. However, after one pieces together all of the definitions, the real discussion of carbon emission and carbon footprint can begin.

## WHAT IS CARBON EMISSION AND CARBON FOOTPRINT?

Carbon emission is the release of carbon dioxide into the air. Carbon footprint is the amount of CO<sub>2</sub> emissions from a single individual, entity, or event. For example:

When you drive your car to and from work, the amount of CO<sub>2</sub> your automobile emits into the air is part of your carbon footprint. If you fly, a percentage of CO<sub>2</sub> emissions from the plane would also be factored into your carbon footprint.

In a similar manner, any activity related to the production of a good or service by a business is part of their carbon footprint.

Even the volcanic eruption we mentioned earlier is identifiable with a carbon footprint based on the amount of CO<sub>2</sub> it releases into the atmosphere.

To that latter point, the addition and subtraction of CO<sub>2</sub> in the atmosphere is a natural process. The single largest source of CO<sub>2</sub> emissions into the atmosphere originates from the ocean. Anthropogenic, or human-made sources account for a much smaller overall portion.

However, while the natural sources maintain a steady balance of CO<sub>2</sub> in and out of the atmosphere, humans have an ever-expanding carbon footprint. According to the EPA, over the past 150 years, humans are responsible for nearly all of the greenhouse gas released into the atmosphere.

Based on the EPAs numbers, greenhouse gas emissions have increased by 1.3% since 1990.

For 2017, the breakdown of greenhouse gas per economic sector looked like this:

- Transportation (28.9 percent of 2017 greenhouse gas emissions): includes emissions from cars, trucks, ships, trains, and planes.
- Electricity production (27.5 percent): includes electricity generated from burning fossil fuels such as coal and natural gas

- Industry (22.2 percent): includes emissions from industry using fossil fuels for energy or emission that results from truing raw materials into goods
- Commercial and Residential (11.6 percent): includes emissions from businesses and homes using fossil fuels for heat, use of greenhouse gas containing products, or handling of waste
- Agriculture (9.0 percent of 2017 greenhouse gas emissions): includes agriculture emissions from livestock, soils, or rice production.
- Land Use and Forestry (offset of 11.1 percent) – based on the utilization of the land, it can either absorb CO<sub>2</sub> from the atmosphere or act as a source of greenhouse gas; for the U.S., since 1990, managed forests, and other lands absorbed more CO<sub>2</sub> than they emitted

## THE CARBON FOOTPRINT OF TRANSPORTATION



Considering that transportation tops the EPA's emission numbers, it comes as no surprise that the auto industry faces scrutiny. As a result, researchers and manufacturers alike are looking to produce cars that lower their carbon footprint.

In the U.S. alone, there are over 270 million vehicles on the road. Personal or light-duty vehicles – cars, trucks, SUVs – make up 60% of transportation emissions. Vehicles responsible for moving freight account for another 23% of emissions. Although it will take considerable time turning over the entire fleet of cars and trucks on U.S. roads – potentially two to three decades – there are signs of progress.

For example, Carbon Engineering, a firm based in Canada, is developing liquid fuel through a process that pulls CO<sub>2</sub> from the atmosphere and pairs it with hydrogen from water. Harvard Applied Physics professor David Keith founded the company. He notes:

*"This isn't going to save the world from the impacts of climate change, but it's going to be a big step on the path to a low-carbon economy."*

While they don't take carbon dioxide from the atmosphere, the increasing popularity of electric vehicles (EV) can help limit future emissions. Unfortunately, even with year over year growth, EV sales still pale in comparison to their gas-powered cousins.

However, there is a lot more to CO<sub>2</sub> reduction in cars and trucks than just the final product.

The actual manufacturing of the automobile makes as much of an impact as driving it. Some studies have indicated that the production of a vehicle accounts for almost 30% of its lifetime CO<sub>2</sub> emissions. Others peg the carbon footprint of building a new car as much higher.

To reduce this, some companies are taking the idea of a "green" car literally.

Polish research firm Selena is developing methods for transforming plants not part of the human food chain into bioplastics for

use in automobiles. The Biomotive project would target interior components, such as the dashboard. Selena research and development director Wojciech Komala, explains:

*"We lower the carbon footprint by using bio-based sources. And by trying to develop lighter components for the cars."*

More conventional solutions include Ford using recycled bottles to create carpets and underbody shields in select car and SUV lines. BMW already uses certain recycled plastic in the manufacture of some of its cars.

Of equal concern are the places where production occurs, and the factories themselves are coming under scrutiny.

Steve Evans, a professor at the University of Cambridge's Institute for Manufacturing, identifies the reduction of energy use at automobile factories as a critical step in reducing a car's carbon footprint. He cites Toyota Europe as a prime example:

*"Toyota in Europe managed to reduce that energy per car by about 8% per year for 14 years. To me, that's the benchmark – that is amazing," he said.*

For Toyota, that means employing everything from solar power to using renewable biomass to the way they design a car and which features they include. They've even been using bioplastics in their vehicles since 2003.

## FINAL THOUGHTS

To be sure, there remains plenty to do if there is any hope of reducing our transportation-based carbon footprint.

As a whole, global carbon emissions reached an all-time high in 2018. Preliminary numbers showed an increase in the U.S. to be 3.4%, the second-highest increase over the past two decades.

Again, transportation led all other sectors, for the third year in a row. And based on recent data, the trends will continue.

In May of this year, CO2 levels reached an all-time high. According to a statement from NOAA, the National Oceanic and Atmospheric Administration:

*Atmospheric carbon dioxide continued its rapid rise in 2019 with the average for May peaking at 414.7 parts per million (ppm). That's not only the highest seasonal peak recorded in 61 years of observations on top of Hawaii's largest volcano, but also the highest level in human history and higher than at any point in millions of years.*

While plenty of initiatives aim to reduce carbon emissions and our nation's carbon footprint, there remains much work to do, particularly when it comes to the impact of transportation.

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